APPENDIX G

AIMING DEVICES

This appendix provides information on the employment of the AN/PEQ-2A target pointer illuminator aiming light (TPIAL), AN/TVS-5, and the AN/PAS-13B (V) 3 heavy weapon thermal sight (HWTS). These devices have the advantage of greater magnification and resolution for the employment of the MK 19 during periods of degraded visibility. These devices, when properly boresighted and employed under proper conditions, allow infantrymen to engage targets at the weapon's maximum effective ranges during periods of degraded visibility.

G-1. AN/PEQ-2A DESCRIPTION AND OPERATION

The TPIAL projects an infrared laser beam that cannot be seen with the eye but can be seen with NVD. It is also capable of projecting a much wider infrared illuminating beam from an integral illuminator. The TPIAL works with night vision goggles and mounts on various weapons with mounting brackets and adapters (Figure G-1 and Table G-1). Leaders can also use the AN/PEQ-2A in the hand-held mode to illuminate and designate targets.

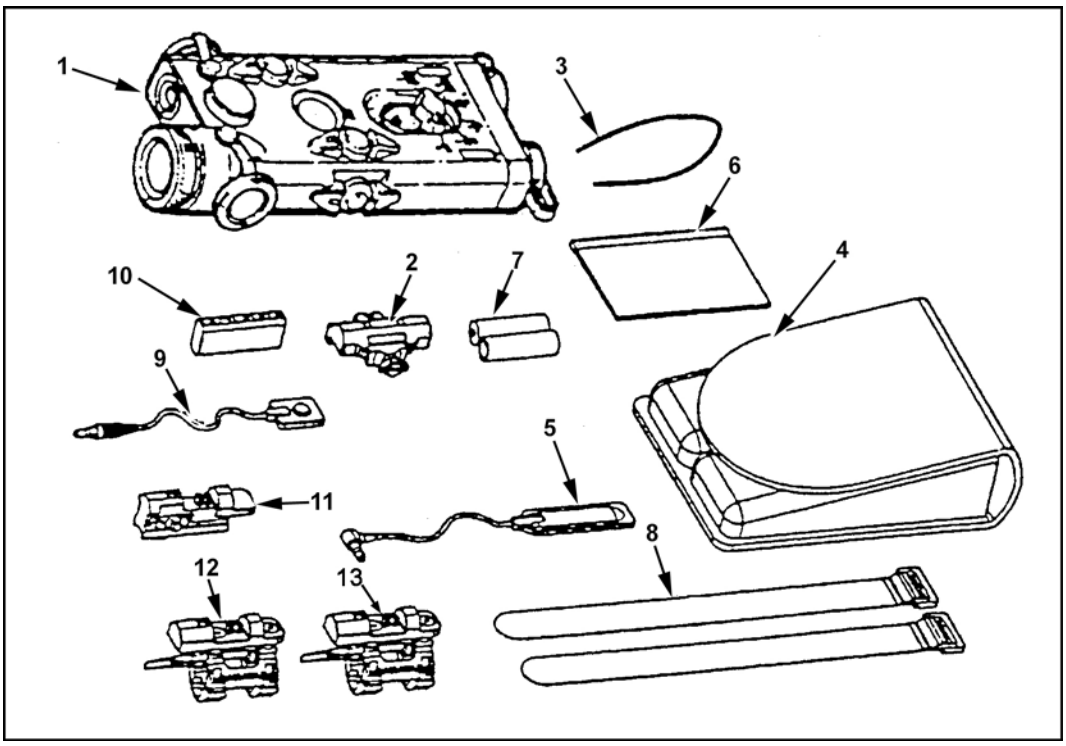

Figure G-1. AN/PEQ-2A major components.

ITEM	DESCRIPTION
1	TPIAL Assembly with Safety Block
2	Rail Grabber Mounting Bracket
3	Neck Cord
4	Carrying Bag
5	Cable Switch, 20 inch Remote, Button
6	Operator's Manual
7	Batteries, 2 AA
8	Straps, Retention
9	Cable Switch, 12 inch, Membrane
10	Bracket Adapter
11	Training Extender (Army only)
12	M4/M16A2 Bracket Assembly (Army only)
13	M16A2 Bracket Assembly (Marine only)

Table G-1. Names of the AN/PEQ-2A major components.

a. **Controls and Indicators.** The AN/PEQ-2A has controls and indicators that allow the user to operate the device and to select its different modes.

(1) ***Battery Installation.*** To install batteries in this device, first unscrew the battery caps and install two AA batteries. Orient the batteries as indicated by the markings on the AN/PEQ-2A body (Figure G-2).

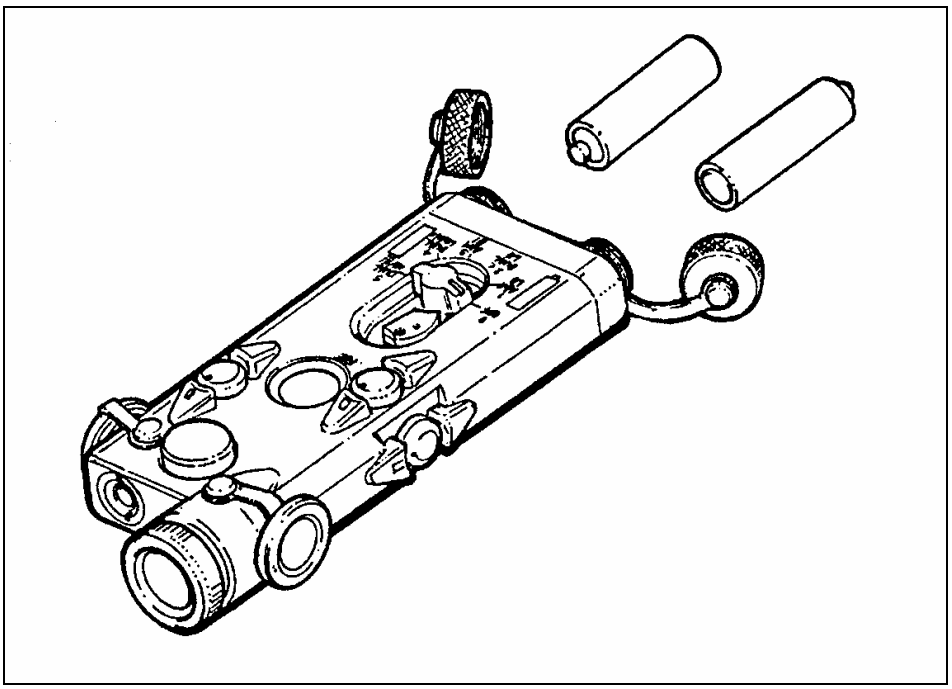

Figure G-2. AN/PEQ-2A battery installation.

(2) ***Safety Block Installation.*** The safety block installed in the training mode (blue side up) prevents the operator from accessing the non-eye safe modes (AIM HI, DUAL

LO/HI, DUAL HI/HI) (Figure G-3). A .050 hex-head Allen Wrench is needed to unscrew the block from the body and re-install it in the tactical mode (black side up).

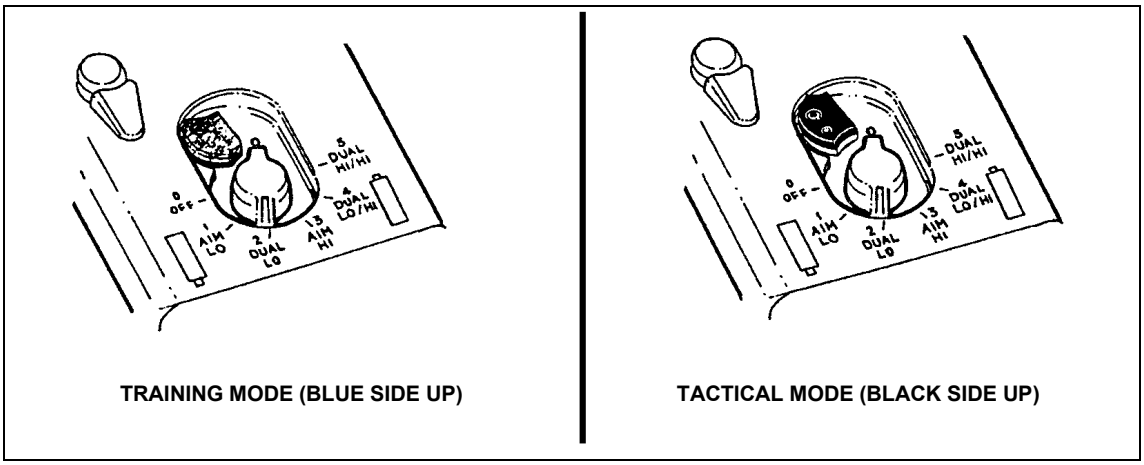

Figure G-3. Safety block installation.

(3) ***Mode Selector.*** The mode selector is used to set the mode in which the AN/PEQ-2A will operate when the cable switch button or push button is depressed. The mode selector has six positions (Table G-2).

KNOB POSITION		OPERATION
0	OFF	The AN/PEQ-2A will not operate.
1	AIM LO	The aiming beam operates at low power.
2	DUAL LO	The aiming beam and the illuminating beam operate at low power.
3	AIM HI	The aiming beam operates at high power.
4	DUAL LO/HI	The aiming beam operates at low power and the illuminating beam operates at full power.
5	DUAL HI/HI	The aiming beam operates at high power and the illuminating beam operates at full power.

Table G-2. Mode selector position.

(4) ***Button Switch.*** The button switch is used when the AN/PEQ-2A is hand held. Pressing the button switch operates the AN/PEQ-2A in the operational mode set by the

mode selector switch (Figure G-4). When the button is released, the AN/PEQ-2A turns off.

(a) A green LED is incorporated into the body of the AN/PEQ-2A to indicate that the unit is ON. Whenever the AN/PEQ-2A is activated, the green LED will light and stay lit until the unit is turned OFF.

(b) If continuous operation of the AN/PEQ-2A is desired, pressing the button switch twice in rapid succession will latch the unit ON. The unit will remain ON until the button switch is pressed the third time.

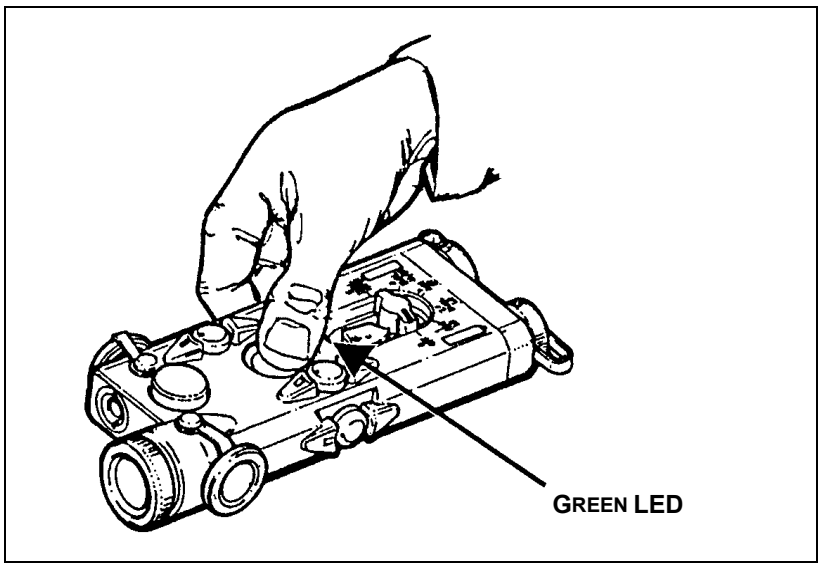

Figure G-4. Operation of the button switch.

(5) ***Cable Switch*.** The cable switch is used when the AN/PEQ-2A is mounted on a weapon (Figure G-5). The cable switch plugs into the back of the AN/PEQ-2A assembly. Pressing the button or pad at the end of the cable switch causes the unit to turn on in the operational mode selected by the mode select switch. When released, the AN/PEQ-2A turns off.

(a) If continuous operation of the AN/PEQ-2A is desired, pressing the cable switch twice in rapid succession will latch the unit ON. The unit will remain on until the push button is pressed a third time.

(b) When the cable switch plug is installed in the AN/PEQ-2A, it automatically locks into place. To remove the switch, pull back on the plug sleeve and pull the plug out.

CAUTION
Do not try to remove the plug by pulling on the cable.

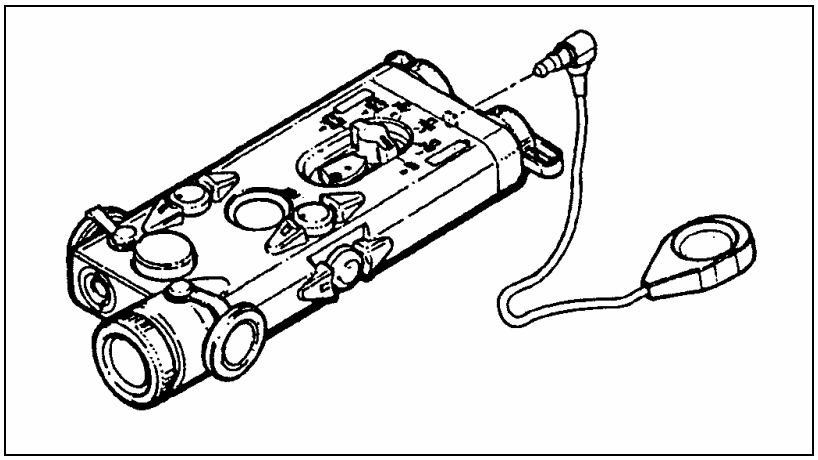

Figure G-5. Installation of the cable switch.

(6) ***Focus Knob.*** The focus knob is used to vary the spread of the illumination beam based on the range and size of the area to be illuminated (Figure G-6).

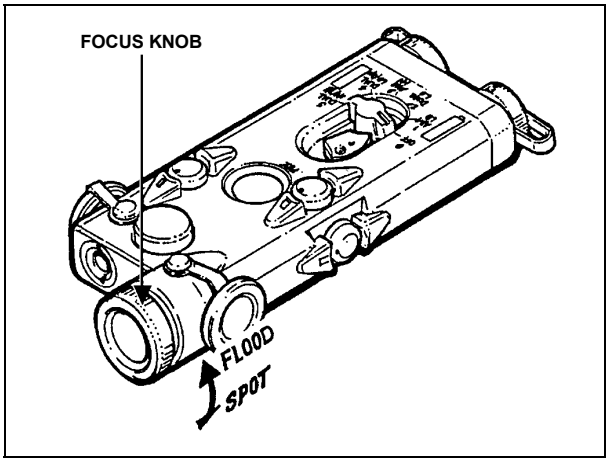

Figure G-6. Using the focus knob.

(7) ***Lens Caps.*** Several lens caps can be used with the AN/PEQ-2A for different purposes (Figure G-7).

(a) The *black lens cap* blocks the AN/PEQ-2A illuminator or aiming laser beam should the device be activated. To use the black lens cap, pull it from its stored location on the side of the unit and stretch it over the front of the focus knob or aiming beam so that it fits snugly in place.

(b) The *diffuser lens cap* enables the illuminator or aiming laser to emit in a 45-degree cone (10 feet at 10 feet). To use the diffuser lens cap, pull it over the front of the focus knob or aiming beam so that it fits snugly in place.

(c) The *neutral density lens cap* enables the AN/PEQ-2A illuminator or aiming laser to be operated in low power. To use the neutral density lens cap, pull it from its stored location on the side of the unit and stretch it over the front of the focus knob or aiming beam so that it fits snugly in place.

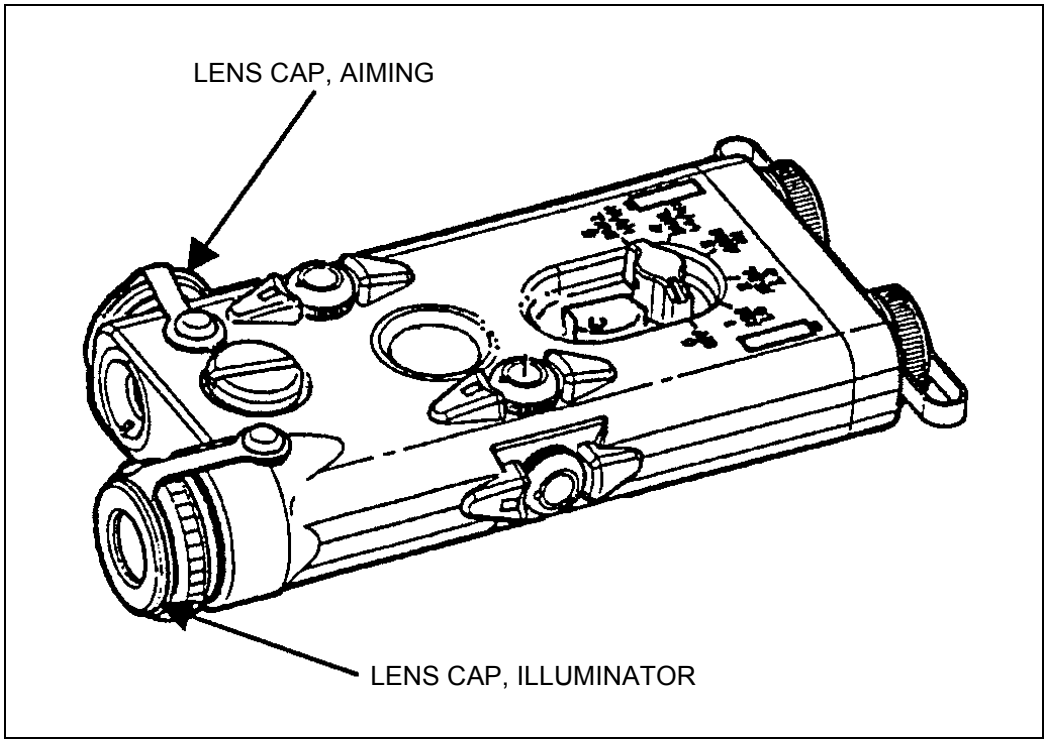

Figure G-7. Installing the lens caps.

(8) ***Boresight Adjusters.*** The AN/PEQ-2A is equipped with boresight adjusters for zeroing the aiming beam and illumination beam to the weapon (Figure G-8). The AN/PEQ-2A adjusters move the beam in true horizontal and vertical directions with the top adjusters used for elevation and the side adjusters for windage. When zeroing the AN/PEQ-2A, it is best to zero the aiming beam to the weapon and then align the illumination beam to the aiming beam.

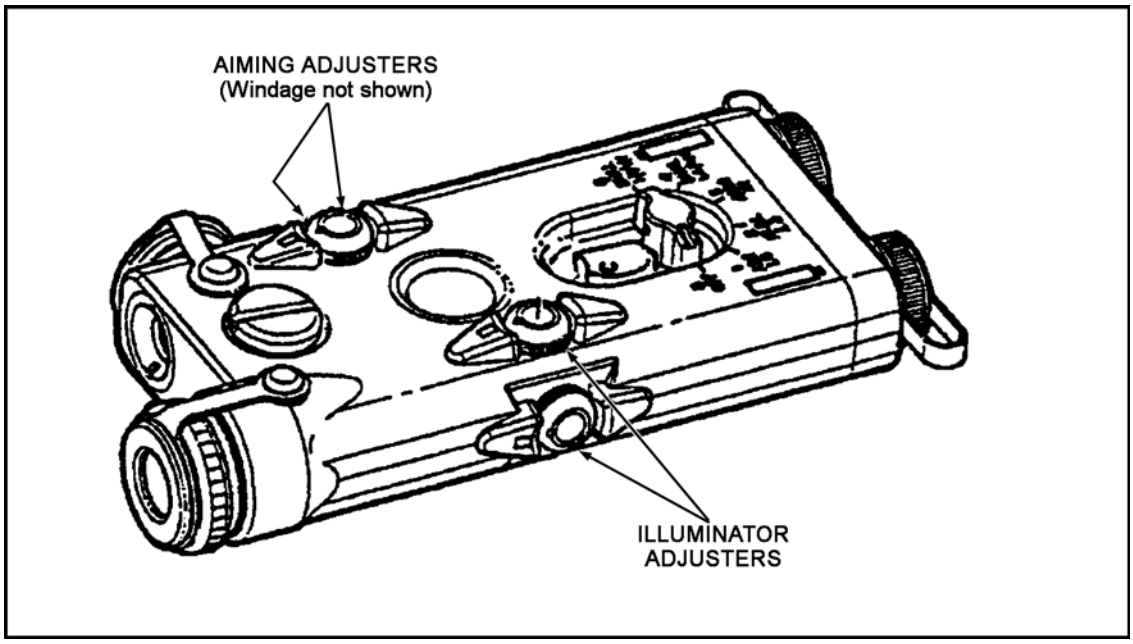

Figure G-8. Boresight adjusters for both aiming and illumination beams.

WARNING

Eye damage can occur if the laser is handled carelessly. The danger area is 15 meters in the training mode and 220 meters in the tactical mode.

b. **Mounting and Dismounting Procedures.** The AN/PEQ-2A can be mounted on various weapons or used in the hand-held mode to illuminate and designate targets.

(1) ***Mounting Procedures*.** Ensure that the mounting bracket is installed before proceeding.

(a) Secure the bracket adapter to the underside of the AN/PEQ-2A.

(b) Place the bracket adapter into the MK 19 bracket mounting groove, located in the center of the rail grabber.

(c) Tighten the bracket's lever screw into the bracket adapter hole.

(d) Plug the cable into the AN/PEQ-2A and run the cable to the front of the MK 19 bracket. The "cable switch, 12-inch, membrane" or the "cable switch, 20-inch, button" may be used for remote access.

(e) Once the cable is secure at the front of the MK 19 bracket (ensure the cable will not become damaged by the movement of the quadrant portion of the bracket) run it between the MK 19 and the bracket to the handles on the backplate assembly. If using the button cable, attach Velcro to the top of the night handle and secure excess cable to the handle. If using the membrane pad, run it the same way as with the button cable and attach the membrane to the inside of the right handle.

(2) ***Dismounting Procedures*.** Dismount the AN/PEQ-2A when the mission is complete, when it is needed on another weapon, or when it will be used in its hand-held mode.

(a) Untie the cable and disconnect the remote button from the backplate handles.

(b) Unplug the cable from the AN/PEQ-2A and place the cable back in the carrying case.

(c) Turn the AN/PEQ-2A mounting screw counterclockwise and remove the AN/PEQ-2A from the bracket adapter.

(d) Unscrew the bracket adapter from the MK 19 bracket rail and place the bracket adapter and the AN/PEQ-2A in its carrying case.

c. **Boresighting Procedures**. Boresighting aligns the sighting system to the bore of the weapon. The AN/PEM-1 Borelight is used for this procedure.

(1) Place the MK 19 in the ready to fire position 10 meters from the bore light offset zero target. Use the 10 meter distance gauge in the borelight kit to measure the distance. Ensure the target and weapon are level and stable (the bore sight zero will be off if not) before making any adjustments to the laser.

(2) Set the range on the MK 19 bracket to 500 meters.

(3) Mount the bore light and turn it on. While holding the MK 19 steady, zero the bore light. Follow the instructions in the AN/PEM-1 borelight operations manual for further details. The 40-mm MK 19 mandrel interface (NSN 3460-01-502-0575) is used with the 5.56-mm mandrel interface and has to be ordered separately.

(4) Make adjustments with the T&E mechanism until the bore light is on the bore light aiming point.

(5) Adjust the windage and elevation of the aiming laser until the laser is on the laser aiming point.

(6) Re-check the bore light aiming point and then the laser aiming point again.

(7) To zero the IR light source narrow the beam as much as possible and adjust its windage and elevation until the beam is 4 centimeters horizontally to the left of the laser aiming point while the aiming laser is still on the laser aiming point. The AN/PEQ-2A is now boresighted.

d. **Zeroing Procedures.** Zeroing the weapon aligns the line of sight of the AN/PEQ-2A with the trajectory of the round so that they intersect at 500 meters.

(1) Set the MK 19 mounting bracket to 500 meters by loosening the friction knob on the left side of the mount. Press and hold the friction knob in (towards the mount), then slide the mount assembly to the 500-meter increment. Release and tighten the friction knob.

(2) Identify a 500-meter target downrange and fire one round; note the impact of the round in relation to the target.

(3) Adjust the aiming light on the AN/PEQ-2A to the impact of the round by adjusting the elevation and windage adjusters.

(4) Manipulate the T&E mechanism so that the aiming light is center mass on the target. Repeat until the point of impact is the same as the point of aim.

(5) Adjust the illuminating beam's elevation and windage adjusters so that the aiming light is in the center of the illuminating beam.

G-2. THE AN/PAS-13B (V) 3 HEAVY WEAPON THERMAL SIGHT

The AN/PAS-13B (V) 3 HWTS is a silent, lightweight, compact, and durable battery-powered infrared imaging sensor that operates with low battery consumption (Figure G-9).

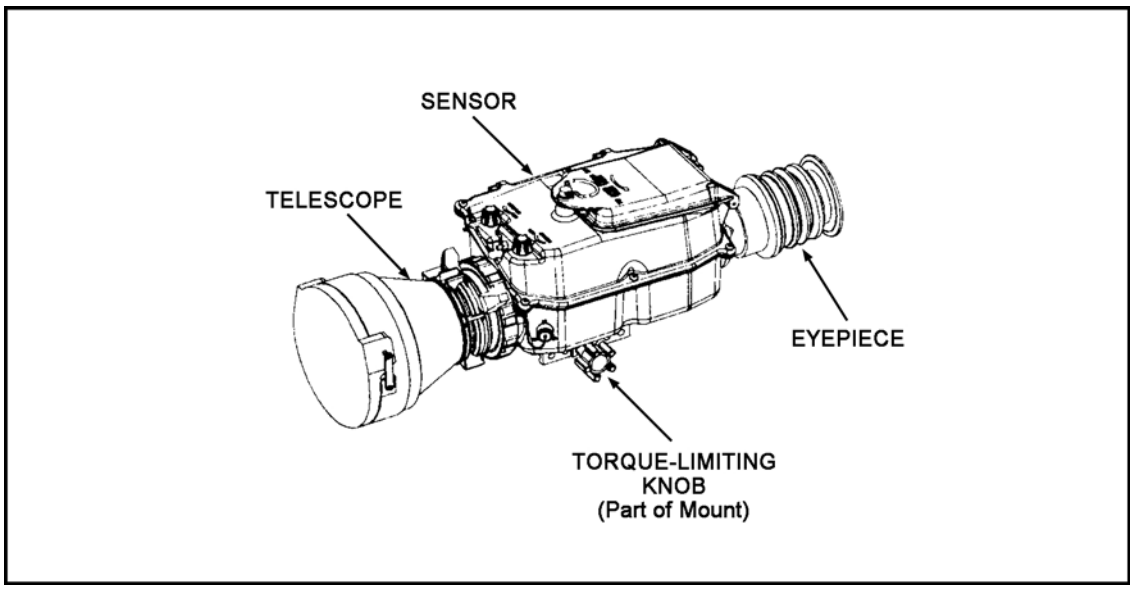

Figure G-9. AN/PAS-13B (V) 3 heavy weapon thermal sight.

a. **Components.** The HWTS is capable of target acquisition under conditions of limited visibility such as darkness, smoke, fog, dust, and haze. The HWTS operates effectively at night and can also be used in the daytime. Infrared light is received through the telescope, detected by an IR sensor, converted to digital data, processed, and then displayed for the user. Besides the carrying cases, the HWTS is composed of four major components: the telescope, the basic sensor, the eyepiece, and the mount.

(1) ***Telescope.*** The telescope receives IR light emitting from an intended target and its surroundings. The telescope magnifies and projects the IR light onto the basic sensor's scanner.

(2) ***Basic Sensor.*** The scanner reflects the IR light received from the telescope onto the detective assembly. The detective assembly senses the IR light and converts it to video. The sensor's electronics condition the video for display on the LED array. The LED array illuminates the IR image along with the reticle. The light from the LED array is reflected off the scanner to form an image at the eyepiece.

(3) ***Eyepiece.*** The eyepiece displays the thermal image and all system indicators on the cathode ray tube.

(4) ***Mount.*** A universal attachment interface between the HWTS and the MK 19 bracket (figure only shows the torque limiting knob).

b. **Modes of Operation.** The HWTS has three modes of operation: STANDBY, ON, and EMERGENCY.

(1) ***STANDBY Mode.*** When the system is first turned on, the HWTS begins a cool down period of approximately two minutes. After the cool down period, the HWTS

enters the STANDBY mode. During the STANDBY mode, power is not applied to the scanner or display in order to extend the life of the battery.

(2) ***ON Mode.*** When the HWTS is in the STANDBY mode and pressure is applied to the eyecup, the HWTS switches to the ON mode, and a switch engages to provide power to the scanner and display. After a three-second delay, the system is fully operational.

(3) ***EMERGENCY Mode.*** When switched to the EMERGENCY mode, the HWTS continuously applies power to the entire system. This allows the operator to bypass the three-second delay experienced when switching from the STANDBY to the ON mode. Since power is applied to the entire system while in the emergency mode, battery life is greatly reduced.

c. **Controls and Indicators.** Controls allow the gunner to configure the sight to the situation and individual preferences while the indicators display the current configuration (Figure G-10 and Table G-3).

(1) The CONTRAST CONTROL adjusts the contrast of the thermal image displayed on the raster. It has an automatic and a manual mode.

CAUTION

Ensure the brightness control switch is depressed before turning it on or off.

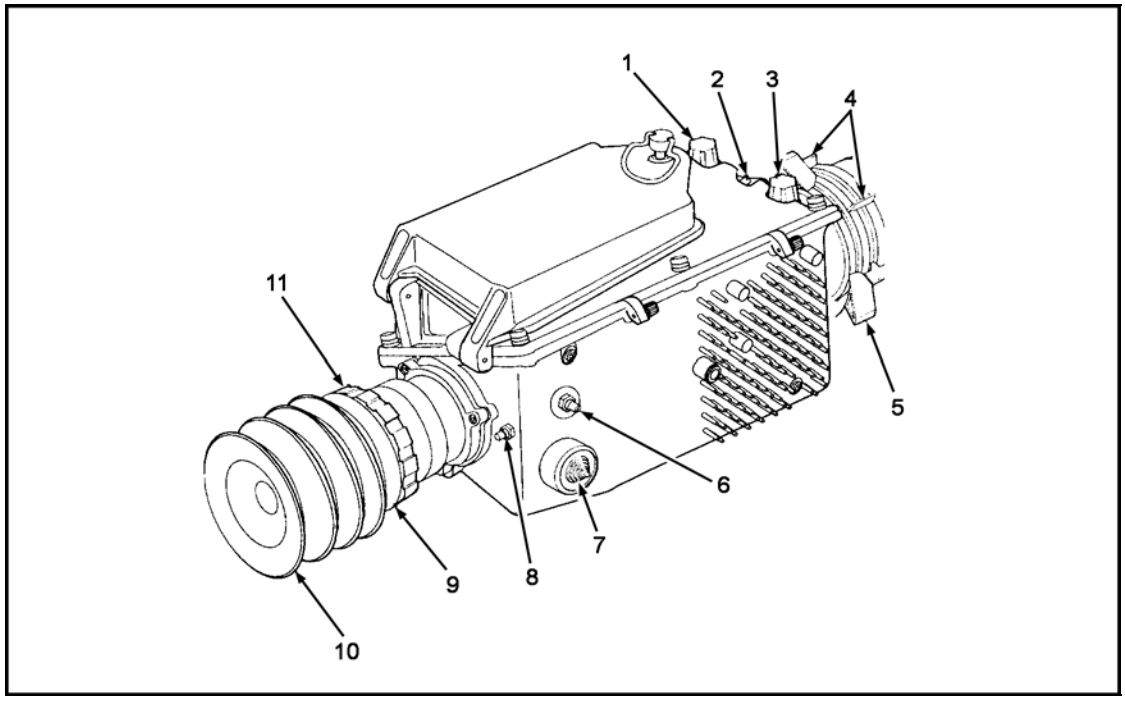

Figure G-10. Location of the HWTS controls and indicators.

ITEM	DESCRIPTION
1	Contrast Control
2	Emergency Switch Control
3	Brightness Control
4	Focus Ring
5	Field of View Ring
6	Zoom/Reticle Select Switch
7	Reticle Adjust Switch
8	Black/White Polarity Switch
9	Diopter Holding Device
10	Eyecup
11	Diopter Focus Ring

Table G-3. HWTS controls and Indicators.

(2) The EMERGENCY SWITCH CONTROL places the HTWS in emergency mode. The eyecup must be depressed in order to for the CRT to illuminate.

(3) The BRIGHTNESS CONTROL is a rotary switch with an off detent position (turned fully counterclockwise). The purpose is to turn the system on or off and adjust the brightness of the eyepiece display.

(4) The FOCUS RING adjusts the telescope focus from 20 meters to infinity. It requires a manual adjustment and affects both the wide and narrow fields of view.

(5) The FIELD OF VIEW RING (FOV) is located on the telescope. It has a wide and a narrow field of view. The wide FOV is for using low magnification during target detection, and the narrow FOV is for using high magnification during recognition and engagement.

(6) The RETICLE SELECT SWITCH selects one of the available reticles depending on the type of thermal sight (medium or heavy) and the weapon. It must be held for two seconds to enable reticle changes. After two seconds, release the switch to cycle to the next reticle. This control is disabled after ten seconds of inactivity.

(7) The RETICLE ADJUST SWITCH adjusts the reticle aiming features in azimuth and elevation. It is used during zeroing, and it must be held for two seconds to allow changes to be made. After two seconds, each press moves the reticle aiming features one increment. This control is also disabled after ten seconds of inactivity.

(8) The BLACK/WHITE POLARITY SWITCH selects the polarity of the thermal image displayed on the raster. The initial setting is “white hot.” The polarity switch affects the appearance of the target.

(9) The DIOPTER HOLDING DEVICE allows the diopter to be adjusted when pulled back.

(10) The EYECUP controls the STANDBY/ON operating mode. When forward pressure is applied to the eyecup, the system is in the ON mode. When forward pressure is removed for more than 30 seconds, the system returns to the STANDBY mode.

(11) The DIOPTER FOCUS RING adjusts the focus of the raster and indicators to the operator's eye. It ranges from +2 to -6 diopters.

d. **Status Indicators and Raster** (Figure G-11)**.** The status indicators and raster are visible when the user presses his eye against the eyecup. The indicators display the system status and configuration. The raster displays the thermal image, the selected reticle, and azimuth/elevation zeroing adjustment indicators.

(1) The status indicators are:

- NOT COOL (1): Displayed when the system is not cool enough for proper operation.
- WHT HOT/BLK HOT (2): Indicates the target polarity.
- EMER (3): Displayed when system is in emergency mode.
- LOW (4): Displayed when battery power is low (approximately fifteen minutes of useful power left).
- FIELD OF VIEW (7): Indicates when the wide field of view (WFOV) or the narrow field of view (NFOV) is in use
- ZOOM (8): Displayed when the zoom mode is selected
- RET ADJ (9): Indicates the reticle adjustment mode is selected
- RET SEL (10): Indicates the reticle select mode is selected

(2) The DISPLAY RASTER displays the thermal image with a superimposed reticle and indicators:

- RETICLE SELECT (5): Identifies the selected reticle/weapon.
- ELEVATION INDICATOR (6): Indicates the elevation zeroing adjustment of the reticle.
- AZIMUTH INDICATOR (11): Indicates the elevation zeroing adjustment of the reticle.
- RANGE SCALE (12): The range scale allows the operator to estimate the range to a target based on a known height or width. The numbers on the scale are the range in hundreds of meters (example: = 400 meters). The vertical lines on the scale reflect the height of a five-foot man at that range. The distance between two consecutive lines reflects the width of a 10-foot tank at the range specified by the vertical line on the left.
- CROSSHAIR/AIMING POINT (13): The vertical line at the aiming point reflects the height of a five-foot man at 800 meters. The horizontal line of the cross-hair reflects the width of a 10-foot tank at 800 meters.

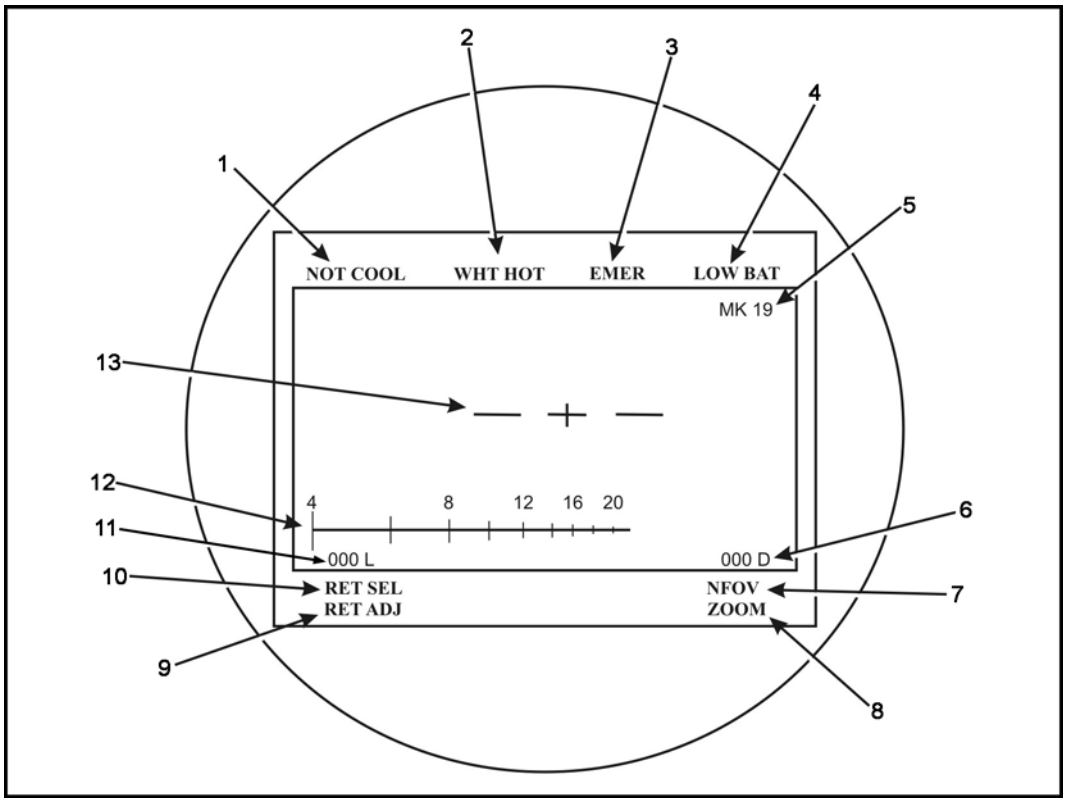

Figure G-11. Status indicators and raster.

e. **Mounting and Dismounting Procedures.** The HWTS is mounted on the MK 19 with a mounting bracket (Figure G-12). See TM 11-5855-312-10 for details.

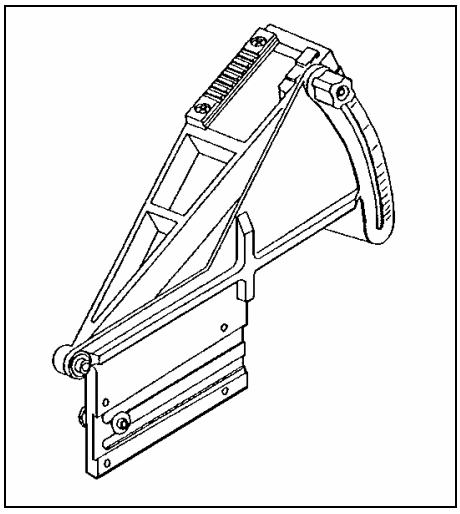

Figure G-12. MK 19 bracket.

(1) ***Mounting Procedures.*** Mounting the HWTS to the MK 19 is a two-step process (Figure G-13):

(a) Mount the bracket to the MK 19 by sliding the bracket into the dovetail slot until the locking pin engages the mount.
(b) Install the HWTS onto the bracket mount.
(c) Shake the HWTS to make sure the sight is secured properly.

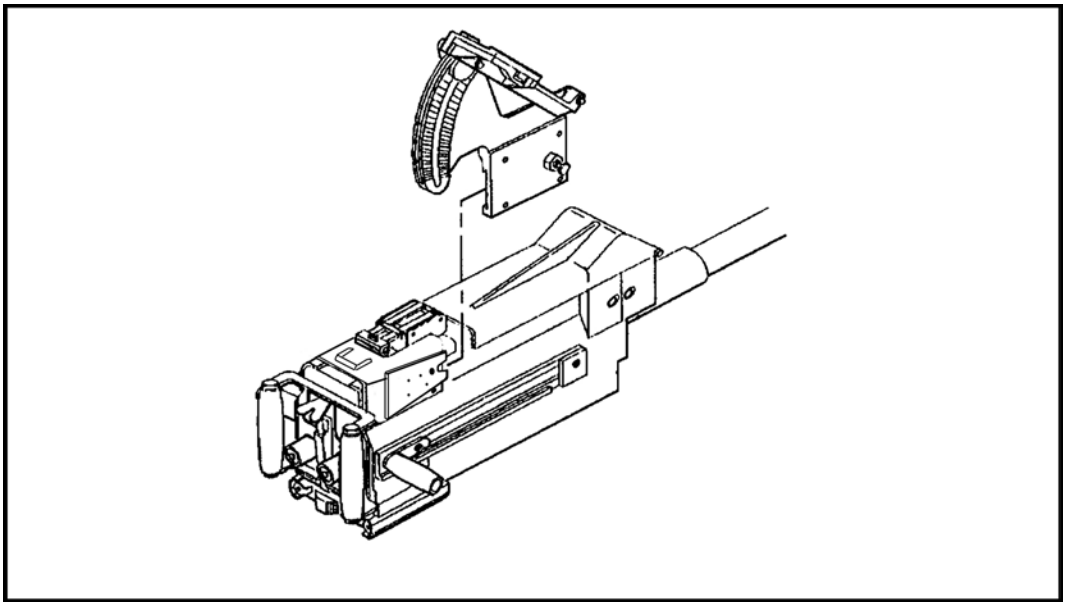

Figure G-13. Mounting the HWTS on MK 19.

(2) ***Dismounting Procedures.*** To dismount the HWTS:
(a) Take the HWTS off the mounting bracket rail and place the HWTS back in its carrying case.
(b) Pull out the locking pin and slide the bracket off the mount.

G-3. AN/TVS-5

The AN/TVS-5 is a portable, battery-operated electro-optical instrument used for observation and aimed fire of weapons at night (Figure G-14 and Table G-4). It amplifies reflected light such as moonlight, starlight, and sky glow so that the viewed scene becomes clearly visible to the operator. The sight does not emit visible or infrared light (except from the eyepiece) that can be detected by the enemy. By using this device, the gunner can observe the area and detect and engage any suitable target.

WARNING

Ensure the weapon is not loaded and is on S (SAFE) before installing the HWTS on the weapon. A loaded weapon may accidentally discharge causing severe injury or death.

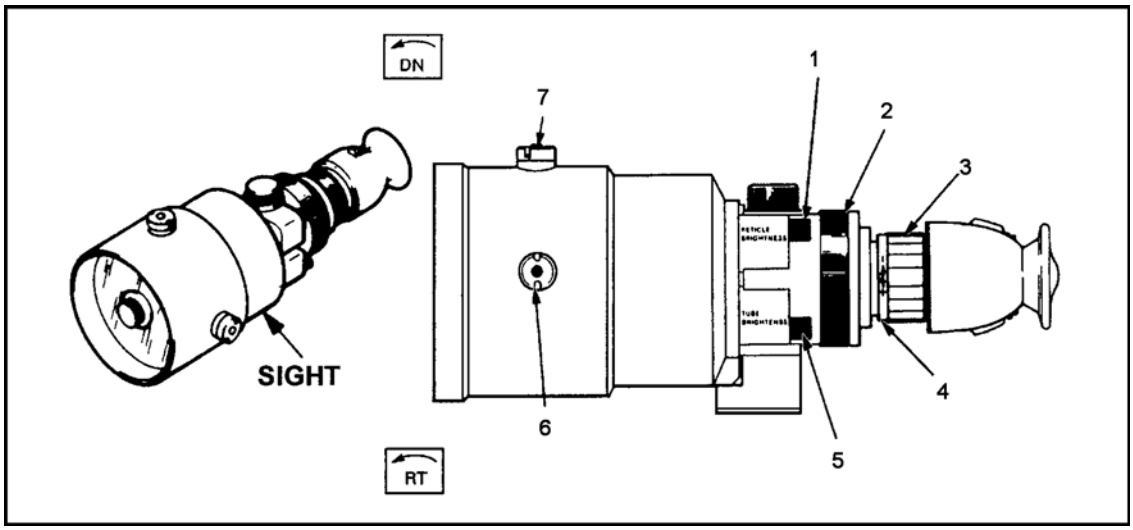

Figure G-14. Location of the AN/TVS-5 components.

ITEM	DESCRIPTION
1	ON-OFF/ Reticle Brightness
2	Objective Focus Ring
3	Diopter Focus Ring
4	Diopter Indicator
5	ON-OFF/ Tube Brightness
6	Reticle Azimuth Adjustment Acutator
7	Reticle Elevation Adjustment Acutator

Table G-4. AN/TVS-5 component names.

a. **Controls and Indicators.**Controls allow the gunner to configure the sight to the situation and individual preferences while indicators display the current configuration.

(1) The ON-OFF/TUBE BRIGHTNESS control applies power to the sight and controls the brightness of the image intensifier tube. It also enables the ON-OFF RETICLE BRIGHTNESS control to function.

(2) The ON-OFF RETICLE BRIGHTNESS control applies power to the reticle and controls the brightness of the reticle.

(3) The OBJECTIVE FOCUS RING adjusts the range focus from 25 meters to infinity.

(4) The DIOPTER FOCUS RING adjusts the focus of the eyepiece.

(5) The DIOPTER INDICATOR indicates the direction of rotation of the DIOPTER FOCUS RING for + and diopters.

(6) The RETICLE ELEVATION ADJUSTMENT ACTUATOR controls the reticle adjustment in the up and down direction. Each click of adjustment moves the strike of the round 1.0 inch at 100 meters.

(7) The RETICLE AZIMUTH ADJUSTMENT ACTUATOR controls reticle adjustment right or left. Each click or adjustment moves the strike of the round 1.0 inch at 100 meters.

b. **AN/TVS-5 Sight Reticle.** The MK 19 and the M2 machine guns share the same AN/TVS-5 sight reticle (Figure G-15).

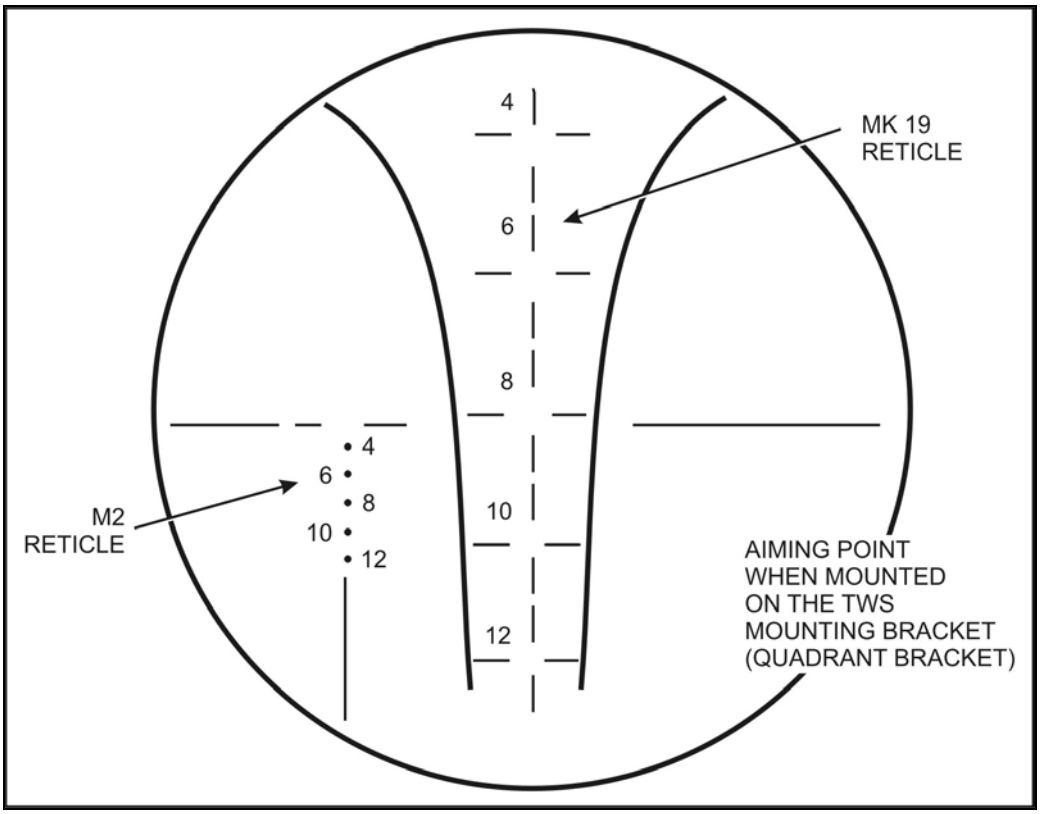

Figure G-15. AN/TVS-5 reticle for the MK 19 and M2 machine guns.

WARNING

1. **Eye guard:**
   - **To avoid recoil injury, attach the eye guard before using the sight.**
   - **When activated by pressure on the eye guard, the sight emits illumination the enemy can detect. Therefore, avoid touching the eye guard except when you wish to use the sight, and then press your eye area against it to activate it.**
2. **Batteries:**
   - **Dispose of batteries as directed. The contents of the mercury batteries cause extreme irritation to the eyes and to oral and nasal passages.**
   - **To prevent explosion, avoid disposing of batteries by burning.**
   - **Avoid short circulating batteries.**
   - **Avoid recharging batteries.**
   - **Remove batteries before storing sight.**
   - **Always replace both mercury batteries at the same time.**

c. **Mounting Procedures**. To mount the AN/TVS-5:

(1) Align the scribe line on the sight with the scribe line on the bracket.

(2) Place the sight in the grove of the bracket and tighten the lever screw clockwise.

(3) Secure the lever screw with lacing wire or tape to ensure the sight does not vibrate loose.

(4) Seat the device. After firing the initial burst, retighten the lever screw to ensure the sight is securely mounted. (If you are unable to fire at this time, lightly shake the sight to ensure the sight is mounted correctly.)

d. **Dismounting Procedures.** To dismount the AN/TVS-5:

(1) Remove the lacing wire or tape from the lever screw.

(2) Loosen the lever screw until the sight is free to be lifted off the bracket.

(3) Remove the batteries and place the sight in its carrying case.

e. **Boresighting.** The AN/TVS-5 cannot be boresighted when used with the MK 19. The sight cannot focus on a target closer than 25 meters, and the offset is too great at that distance to boresight accurately.

f. **Zeroing.** To zero the AN/TVS-5 to the MK 19, follow the procedures in TM 11-5855-214-10.